

Selective laser trabeculoplasty

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Foundation items: Research Fund from Health Department of Hunan Province, China (No. B2009004); Research Fund from Department of finance of Hunan Province, China (No. 2008-115)

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Received: 2012-11-12 Accepted: 2012-12-01

Abstract

• The introduction of selective laser trabeculoplasty (SLT) provided a new choice for the reduction of intraocular pressure (IOP) in eyes with open angle glaucoma (OAG) and ocular hypertension (OHT). SLT was demonstrated equally as effective as topical medical therapy and argon laser trabeculoplasty (ALT) to lower IOP. It is a potentially repeatable procedure because of the lack of coagulation damage to the trabecular meshwork (TM) and also effect in patients with previously failed ALT. SLT can be used to treat patients with OAG, pseudoexfoliation glaucoma, pigmentary glaucoma, normal-tension glaucoma, OHT, juvenile glaucoma, pseudophakic and aphakic glaucoma. Furthermore, SLT can be considered as a primary treatment option in patients who cannot tolerate or are noncompliant with medications, while not interfering with the success of future surgery. Its safety profiles include mild and transient inflammation, ocular pain and a small risk of moderate IOP elevations after the procedure. SLT is a safe and effective means of IOP reduction in eyes with OAG and OHT.

• **KEYWORDS:** open angle glaucoma; intraocular pressure; selective laser trabeculoplasty

DOI:10.3980/j.issn.2222-3959.2012.06.17

Shi JM, Jia SB. Selective laser trabeculoplasty. *Int J Ophthalmol* 2012;5(6):742-749

INTRODUCTION

The mainstay treatment for open angle glaucoma (OAG) is to lower intraocular pressure (IOP) preventing

further glaucomatous damage of the optic nerve. Currently, there are three methods available to achieve this goal: medication, laser treatments and surgery. When a patient is diagnosed as glaucoma, doctor will recommend one or a combination of one or two above strategies. The treatment options are based upon the following factors: type of glaucoma, the situation of the optic nerve damage, patient's symptoms and compliance with daily medications.

Lasers with various wavelengths, particularly the argon laser, have been used for trabeculoplasty for more than 30 years^[1]. Since last century 80s, Argon laser trabeculoplasty (ALT) has been proven to be effective for treating patients with OAG, as shown in the Glaucoma Laser Trial (GLT) and the GLT Follow-up Study^[2]. Studies showed the eyes initially treated with ALT had lower IOP and better visual field and optic disk status than their fellow eyes treated initially with topical medication^[2]. However, ALT also had some significant side effects postoperatively, such as transient IOP spikes (6.3%-53%), peripheral anterior synechiae (12% -47%) and uveitis. Histopathologic studies revealed damage of the TM, which may limit retreatment with ALT^[3]. There is also a debate regarding ALT positioning in the treatment algorithm of OAG. Most of the complications are related to the amount of energy delivered to the TM. The higher failure rate of ALT was reported. Thus, a body of research focused on some new laser techniques to reduce laser energy and minimize complications was established.

DEVELOPMENT OF SLT

In 1983, Anderson and Parrish^[4] found that suitably brief pulses of selectively absorbed optical radiation could cause damage to pigmented structures and could be selectively confined to the irradiated cell. This was named selective photothermolysis. *In vitro* studies performed by Latina and Park^[5] demonstrated that selective targeting of pigmented TM cells was possible by using pulsed lasers with low threshold radiant exposures, thus avoiding collateral damage to adjacent non-pigmented TM cells. Their study formed the basis of the currently available SLT system and its treatment parameters was 532nm frequency doubled, Q-switched Nd:YAG laser providing a 3ns pulse with a 400 μ m beam diameter. SLT was introduced worldwide in 1995. A pilot study performed in 1998 demonstrated that SLT was a safe

and effective technique to lower IOP in patients with OAG and in patients treated previously with ALT^[6]. Subsequently, SLT was integrated into glaucoma practice. It was approved by Food and Drug Administration of USA in March 2001. Kramer and Noecker^[7] compared the histopathologic changes in the human TM after ALT and SLT by scanning electron microscopy. Unlike ALT, there was no evidence of coagulation damage or disruption of the corneoscleral or uveal trabecular beam structure in human cadaver eyes after SLT. Its' short pulse duration is below the thermal relaxation time of the tissue, and therefore causes no thermal damage. The spot size is fixed at 400 μ m, which encompasses the entire meshwork from Schwalbe's line to the ciliary body band. The laser energy is uniformly distributed to evenly treat the TM encompassing an area only 1% of that of ALT. Therefore, it was demonstrated that SLT would be a safer and more repeatable procedure than ALT. Another comparison of ultra structure morphological changes by low power ALT and SLT using light and transmission electron microscopy found less fragmentation of the trabecular beam and better preservation of the inner wall of Schlemm's canal with SLT. In present study, SLT was demonstrated less destruction and greater preservation of long-spacing collagen than ALT^[8].

However, the mechanisms of ALT and SLT are not completely clear. The mechanical theory of IOP reduction in ALT proposes that a thermal burn contracts TM tissue and stretches open adjacent, untreated regions of the TM to increase outflow. Some researchers found that there were also cytokins involved^[9]. SLT may initiate a series of biological events that promote IOP reduction without the thermal and structural damage associated with ALT^[10-12].

Rachmiel *et al*^[13] analyzed the trends of laser trabeculoplasty (LTP) from 1992 to 2004 in Ontario, Canada. They found that the number of filtration surgeries had a 2.4% annual decrease since 1996 and the number of antiglaucoma medications had a 10.5% annual increase from 1992 to 2004. The number of LTP per 1 000 persons had a 1.96% annual increase from 1992 to 1996, and then steadily decreased 14% annually until 2001, without correlation with the introduction of newer medications for the treatment of glaucoma. A significant increase of 32% annually in LTPs was noted from 2002 to 2004, which coincided with the introduction of SLT.

OUTCOME OF SLT

A number of publications demonstrated the efficacy of SLT as an IOP lowering modality. In these studies, IOP reductions ranged from 2.1 to 10.6mmHg (12.1%- 39.9%) with follow-up ranging from 4 weeks to 72 months^[14,17-20].

Kano *et al*^[15] followed 67 eyes and noted mean IOP reduction was 4.4mmHg and success rate was 64.6% at 6 months after 180° SLT treatment. A study of Gracner^[16] showed an IOP reduction up to 5.66mmHg (25.2%) at 6 months follow-up in 50 eyes treated with 180° SLT. Another study of Gracner *et al*^[17] documented satisfying results with 72 months follow-up and an enlarged sample of 90 eyes, though the effect diminished over time. The mean pretreatment IOP was 22.4 \pm 2.3mmHg. At the end of 72 months follow-up, mean IOP reduction was 5.4mmHg (22.8%). The success rate after 12 months determined by Kaplan-Meier survival analysis was 94%, 85%, 74%, 68% and 59% after 24, 36, 48, 60 and 72 months, respectively. Cvenkel^[18] reported 4.4mmHg (17.1%) IOP reduction at 12 months follow-up and 62% of eyes achieved 3mmHg or more IOP reduction.

However, there is a tendency of increasing IOP through a longer period of time. Weinand and Althen^[19] reported a series of 52 POAG eyes that were treated with SLT on 180° TM (50 spots) at energy levels ranging from 0.6 to 1.4mJ per pulse. The average IOP reduction from baseline was 6.0mmHg (24.3%), 6.12mmHg (27.8%), 5.53mmHg (24.5%) and 6.33mmHg (29.3%) at 1 year, 2, 3, 4 years follow-up respectively. Success rate according to Kaplan-Meier survival analysis was 60%, 53%, 44%, 44% at 1 year, 2, 3, 4 years, respectively.

COMPARISON OF TREATMENT PORTION OF SLT

According to a multicenter, pilot, clinical study of selective laser trabeculoplasty by Latina *et al*^[6], they delivered 50 to 100 non-overlapping laser spots over 180° to 360° of TM. The guiding principle of SLT, like any other therapy, is to apply the minimum amount of treatment necessary to achieve the desired therapeutic benefit. However, several studies have done to compare IOP lowering effects of SLT with different portion of TM treated. Chen *et al*^[21] performed a prospective controlled study of 32 OAG patients treated with 25 laser spots on 90° of TM, matched with 32 patients underwent 50 laser spots treatment on 180° TM. They concluded there was no difference in the pressure reduction between two treatment regimens. In another retrospective study including 120 eyes, Chen concluded that the long-term effects of 90° SLT seem to be low. The authors recommend to treat patients over 180° TM as tradition^[22]. On the contrary, Nagar *et al*^[23] found that 90° SLT was generally not effective, but there was no statistical significance difference between 180° and 360° SLT, although success rates were greater with 360° than 180° SLT treatments.

A prospective study performed by Goyal *et al*^[24] also found no statistically significant differences between the 360° and

180° SLT treatment groups. But Prasad *et al*^[25] concluded that 360° SLT was more efficacious in achieving smaller IOP fluctuations than 180° SLT during 6 to 24 months follow-up after reviewing charts of 41 patients. And Shibata *et al*^[26] also documented 360° SLT was more effective than 180° SLT in IOP reduction in Japanese patients with OAG as an adjunctive treatment protocol.

Another study performed by George *et al*^[27] to compare IOP response of a modified SLT protocol with 100 overlapping laser spots over 180 degrees of TM with 100 nonoverlapping spots over 360 degrees and another group patients who received ALT with 50 spots over 180 degrees. They concluded that overlapping application of SLT resulted in a poorer IOP response compared with ALT and non-overlapping SLT.

SLT VERSUS MEDICATIONS

As a first-line treatment for glaucoma, medications have many disadvantages. Patients have to tolerate drug side effects, repeated application of drugs and ongoing medical costs. The effectiveness of the treatment may be undercut when patients are non-compliant.

The advent of SLT, which utilizes a milder energy to induce IOP-lowering effect without harmful side effects, has again raised the question: can laser treatment beat topical medications as a primary solution for OAG? In the preliminary published studies, SLT was used as adjunct therapy to medication. Later several studies had suggested that SLT might be primary therapy for POAG or OHT^[23, 28-31]. Melamed *et al*^[28] found 40 in 45 eyes (89%) which underwent SLT as primary treatment had an IOP decrease of 5mmHg or more. Mean IOP reduction was 7.7 ± 3.5 mmHg (30%) at 18 months post-SLT. A prospective, multicenter study by McIlraith *et al*^[29] included 100 eyes (61 patients) with newly diagnosed POAG or OHT. IOP reduction was 8.3mmHg (31.0%) in the SLT group (74 eyes) compared with 7.7mmHg (30.6%) in the latanoprost group (26 eyes) ($P=0.208$ and $P=0.879$). The amount of IOP reduction was statistically significantly less in the latanoprost group than in the SLT group. However, Nagar *et al*^[23] demonstrated there was no difference in success rates between latanoprost and 360° SLT treatment at the end of 12 months follow-up. But success rates (defined in terms of both a 20% or more IOP reduction and a 30% or more IOP reduction from baseline measurements without additional antiglaucoma therapy) were higher with latanoprost 0.005% at night than with 90° and 180° SLT treatments. Lai *et al*^[30] randomized both eyes of 29 Chinese patients with newly diagnosed POAG or OHT to two treatment arms of SLT and medication for 5 years follow-up. There was no statistically significant difference in

the baseline IOP and IOP reductions between the two arms at all time intervals. And a prospective randomized study performed by Katz *et al*^[32] compared SLT (100 applications 360°) with prostaglandin analog. Their study indicated that IOP reduction was similar in both groups after 9 to 12 months follow-up. But more treatment steps were necessary to maintain target IOP in the medication group. Lots of studies came to a conclusion that both SLT and latanoprost had a significant effect on IOP control and IOP fluctuation. While latanoprost may be more likely to reduce IOP fluctuation, SLT has the benefit of being a one-time intervention not requiring ongoing patient compliance^[33].

So many papers talked about the similar IOP lowering effect with SLT and Prostaglandin Analogs. While one laboratory trial try to tell how it happened^[34]. They found exposure to factors secreted by lasered Schlemm canal cells and lasered TM cells and the application of prostaglandin analogs induced junction disassembly while increasing the permeability of Schlemm canal cells. These findings suggested that SLT and prostaglandin analogs might share a common mechanism that likely mediated their pressure-lowering effects.

Although economics should not drive the treatment paradigm, it should be a consideration. Lee and Hutnik^[35] compared the average annual cost of medications with the cost of SLT for patients enrolled in the Ontario Health Insurance Plan. The results from this 6-year cost projection suggested SLT should be regarded as a moderately less costly treatment alternative in the existing set of OAG therapies available and should be considered particularly for patients in whom compliance, adherence, and side effects to medication may be an issue. While, Buys^[36] considered Lee's analysis overestimates the efficacy and safety of SLT. Thus, a prospective randomized clinical trial comparing the cost of SLT to medical therapy is required.

SLT VERSUS ALT

Encouraged by initial results of SLT, several clinical trials were undertaken to compare SLT with ALT, indicating SLT has equal or more favorable outcomes to ALT^[37-41]. Damji *et al*^[42] performed a prospective randomized clinical trial and documented 4.8mmHg (21.9%) and 4.7mmHg (21.3%) of IOP reduction in the ALT and SLT group, respectively. SLT appeared to be equivalent to ALT in lowering IOP during the first 6 months after treatment. Patients with previous failed ALT had a better reduction in IOP with SLT than with repeated ALT (6.8 ± 2.4 vs 3.6 ± 1.8 mmHg, $P=0.01$). Another study performed by Damji *et al*^[37] enrolled 176 eyes of 152 patients with 89 eyes in the 180° SLT group and 87eyes in the 180° ALT group. Mean IOP reduction in

eyes treated with SLT was 5.86mmHg and it was 6.04mmHg in eyes treated with ALT at 1 year post-laser. The percentage of eyes that achieved $\geq 20\%$ IOP reduction in the ALT and SLT group was 60.3% and 59.7% respectively. There was no significant difference between the two groups. Juzych *et al* [38] studied 195 eyes with 154 underwent 180° ALT and 41 underwent 180° SLT for a maximum follow-up of 5 years. Success criterion was defined as criterion I: a decrease in IOP of 3mmHg or more and criterion II: a 20% or more IOP reduction was required for success with no additional medications, laser or glaucoma surgery. Percentage of IOP reduction at 1 year, 2, 3, 4, 5 years post-laser in the SLT group was 18.1%, 23.4%, 23.4, 21.2%, and 27.1%, respectively, and 18.1%, 19.2%, 20.8%, 19.1%, and 23.5% in the ALT group, respectively. They found no difference between two groups by either criterion over the 5-year period. A prospective study performed by Martinez-de-la-Casa *et al* [39] suggested pressure reduction was similar with 180° SLT (22.2%) and 180° ALT (19.5%) at 6 months follow-up post laser. But the energy employed in SLT group was significantly lower than that of ALT ($48.3 \pm 7.4\text{mJ}$ vs $4321 \pm 241.7\text{mJ}$, $P < 0.001$). And SLT procedure was better tolerated, with less discomfort and postoperative inflammation in anterior chamber. Popiela *et al* [40,41] found short term efficacy of ALT and SLT was similar. Samples *et al* [43] also concluded that there is no evidence for superiority of any particular form of laser trabeculoplasty after reviewing 145 clinically relevant literatures.

One prospective randomized clinical trial was performed to compare the long-term IOP lowering effects of SLT and ALT. 176 eyes of 152 patients with uncontrolled IOP on maximal tolerated medical therapy (MTMT, with or without previous ALT) were included in this study. Baseline parameters were similar in two groups. Lowering of IOP were similar at 3 years (SLT -6.7 ± 7.1 vs ALT -6.1 ± 5.1); at 4 years (SLT 7.0 ± 7.7 vs ALT -6.3 ± 5.0); and at 5 years (SLT -7.4 ± 7.3 vs ALT -6.7 ± 6.6). There was no statistically significant change in IOP in either of the two groups. A number of interventions were required in both groups, cumulatively, over the 5-year follow-up period (49 SLT and 33 ALT). Survival analysis indicated that the time to 50% failure in each group was approximately 2 years. They concluded IOP-lowering effects of SLT and ALT were similar over 5 years in this group of patients with OAG on MTMT [44]. However, one long term (14 years) retrospective study documented ALT may have a better ability to lower IOP. Baseline IOP was significant higher in ALT group compared with SLT group (24.2 ± 5.4 vs 22.2 ± 4.6 , $P <$

0.0001). But it was similar at one year (19.6 ± 5.1 vs 19.5 ± 6.1) [45]. More long term studys should be performed to clarify this problem.

SLT AFTER ALT

It was suggested that patients who have prior ALT may still benefit from SLT [20,21,46]. In fact some studies showed IOP reduction was not influenced by previous ALT treatment [21,38,47,48]. Conversely, some other studies indicated patients with previous failed ALT had a better reduction of IOP or success rate after additional SLT [20]. In a pilot study by Latina *et al* [6], 23 patients with failed ALT were treated with SLT and followed up for 26 weeks. IOP reduction in this group (6.0mmHg) was found to be no difference from a previously untreated POAG group (5.8mmHg). Chen *et al* [21] also described a similar pressure-reduction effect with or without previous ALT. In a comparative study, Damji *et al* [42] showed a greater IOP drop with SLT after failed ALT of 6.8mmHg versus an ALT retreatment (3.6mmHg) ($P < 0.01$). Birt [48] also reported that SLT after 360° ALT was efficacious in patients with pseudoexfoliation glaucoma and pigmentary glaucoma.

But there are some questions which were not answered in published paper, such as: degree of circumference and location of angle ALT treated, and the relationship between location of prior ALT and SLT. Shi *et al* [46] defined a classification system to clarify analysis outcome of SLT. In 352 eyes, success was defined as at least 20% IOP reduction from baseline without further medications or surgeries. Patients were divided into 3 groups based upon previous ALT treatment: without prior ALT treatment, with 180° prior ALT treatment and with 360° prior ALT treatment. Patients were further classified according to the circumference of the angle treated with SLT and its relationship to previous ALT. SLT was successful in 83%, 84% and 84% of eyes with median survival times of 10.9, 10.2, and 6.2 months in 3 different groups, respectively. It was successful in 93% and 89% of eyes with median survival times of 29.3 and 11.9 months in patients treated with 180° SLT on contralateral side and ipsilateral side of prior ALT, respectively. Their study indicated that patients with prior 360° ALT did not appear to do as well as those having no ALT or prior 180° ALT. SLT performed in a different area from previously ALT treated may be more successful than retreatment in the same area.

INDICATIONS FOR SLT

Theoretically, the indications for SLT should be the same as ALT, and it may be effective for patients with failed ALT. The pilot study of Latina *et al* [6] included OAG and OAG with prior ALT. However, SLT could be used in other

conditions because of its nondestructive nature. Succeeding studies also showed considerable success in pseudoexfoliation glaucoma [20,40,41,49], pigmentary glaucoma [20,40,41,49,50], normal-tension glaucoma [10,20,40,50], OHT [10,20,41,50], juvenile glaucoma [10,40], pseudophakic and aphakic glaucoma [10,20,51].

SLT should also be a good choice for those patients who can not tolerate medications or with poor compliance as a primary treatment and it can be chosen as an adjunct treatment to medication. Several studies also suggest that SLT is a temporizing treatment and prophylactic procedure to consider in patients with elevated IOP after intravitreal triaminolone acetonide injection [52-56]. SLT may also be a good choice for patients with uncontrolled IOP after trabeculectomy who may be unable to tolerate or reluctant to undergo additional invasive glaucoma surgery [57]. And SLT can also reduce IOP in many eyes with primary angle closure and a patent iridotomy in which there is a sufficient extent of visible trabecular meshwork [58].

OUTCOME PREDICTORS OF SLT

Assessment of risk factors may determine which patients have a greater probability of gaining acceptable IOP reduction. Consideration of the prediction rules in clinical practice may improve quality of treatment for glaucoma patients.

Although pigmentation on the TM may play a role in determining the outcome of SLT theoretically, several studies found that IOP reduction after SLT treatment was positively associated with baseline IOP [15,42,49,50,59]. And One paper indicated that patients treated with SLT as primary therapy who had thinner corneas (central corneal thickness, CCT < 555µ m) demonstrated better IOP control for at least 30 months after SLT [60]. There is no discernible association between the success of SLT and age, sex and history of past ocular surgery, phakic status [15,42,50,51,59]. Classes of antiglaucoma medications, diabetes are also not associated with SLT treatment efficacy [51]. And anterior chamber angle pigmentation [15,50,51], types of glaucoma (POAG, pseudoexfoliation glaucoma, pigmentary glaucoma, combined-mechanism glaucoma and juvenile glaucoma) [50] and washout of eye drops [50,51] did not show effect on success of SLT as well. But Chen *et al* [21] documented that preoperative pigmentation was correlated with the IOP-lowering effect of SLT at 7 months, and the effect was more prominent in the presence of pseudoexfoliation. In a long-term study by Chen showing relatively poor IOP reduction with SLT in pseudoexfoliative glaucoma patients [22]. These observations need for further investigation.

EFFECT OF SLT IN DIFFERENT RACE

While most SLT results stem from non-Hispanic Caucasian subjects, the response in Asian patients also has been documented. Lai *et al* [30] concluded that the IOP-lowering effect of SLT in Chinese patients with POAG or OHT is as effective as topical medications. IOP-lowering effect of SLT was also observed in the study of Shi *et al* [46] which included African-American, and Hispanic patients in addition to Caucasians and Asians. And favorable results were also obtained in Japanese people [15,26] and Egyptian patients [61].

COMPLICATIONS OF SLT

Most studies reported relatively low complication rates, and this may be because SLT delivers only 1% of the energy of ALT. Up to 50% of patients showed a mild to moderate uveitis in the immediate postoperative period, but it rarely persisted for more than 24 hours and can be managed with anti-inflammatory agents [22]. McIlraith *et al* [29] demonstrated that non-steroids anti-inflammatory therapy had similar efficacy to steroids after laser surgery. Transient IOP elevation has been reported from 0 to 27% [22,28]. These spikes are seen within 2 hours after surgery, resolve within 24 hours, and respond well to medical therapy. Some authors choose to pre-treat patients with brimonidine 0.2% and pilocarpine 1%, while others also administer a drop of brimonidine 0.2% following laser to reduce the IOP spike rate [20,27,28,30,41]. Van de Veire *et al* [41] found that patients with pigment dispersion glaucoma who underwent SLT had a paradoxical rise in IOP. They suggested that lower energies (0.4 to 0.6mJ) are required when performing SLT in patients with heavily pigmented TM. Harasymowycz *et al* [62] also reported a case series with significant post-SLT IOP elevation which necessitated both medical treatment and trabeculectomy in treated eyes. They suggest that significant post-SLT IOP elevation can be a serious adverse event in some cases of pigmentary glaucoma or glaucoma with heavy angle pigmentation or both. Theoretically, modifying the SLT settings with lower energy, fewer applications, and/or treating a lesser amount of TM may decrease this risk.

One case of hyphema occurring during SLT in an eye without neovascularization was described, though it was transient and IOP was controlled successfully [63]. Rhee *et al* [64] also reported a case of hyphema presented 3 days after SLT. Careful monitoring of IOP and anterior chamber reaction during and after SLT is advised. A finding of post-SLT cornea edema, which resolved after topical anti-inflammatory agents, was reported by Moubayed *et al* [65]. Regina *et al* [66] also observed cornea edema following SLT which resolved with corneal scarring and thinning left. And it is also reported SLT can cause transient corneal

endothelial changes in patients after SLT without impact on cell count or visual acuity [67]. No vitreous haze and significant increase in macular thickness were present in a prospective study with 64 eyes of 64 patients included [68].

CROSSOVER EFFECT OF SLT

SLT appears to have a statistically significant pressure lowering effect on the untreated eye in some studies. There may be a proposed systemic biologic effect of SLT decreasing the IOP in the contralateral eye, which is not the effect by laser's mechanical effect. In the pilot study, Latina *et al* [6] reported a 9.7% IOP reduction in the contralateral eyes after 6 months of SLT treatment. McIlraith *et al* [29] demonstrated an 8% IOP reduction in 23 untreated fellow eyes in their 12-month follow up. Rhodes *et al* [59] also found an 11.2% (2.1±0.5mmHg) IOP reduction in the untreated fellow eyes at 6 months post-laser.

IOP reduction in the treated eyes also has a predictive effect of SLT response in the fellow eye. In patients with OHT and POAG, in the 3rd-month percentage of IOP reduction in the first treated eye in response to SLT was predictive of response in the fellow eye up to 30 months and 9 months, respectively [69]. Further study is needed to determine which patients might benefit from the biologic effects of SLT and to clarify this mechanism.

RETREATMENT OF SLT

There are few reports about repeat treatment of SLT and the definition of repeat treatment is unclear. It is our opinion that repeat enhancement should be defined as treatment over a previously untreated area of TM. Repeat treatment is defined as treatment over a previously treated area of TM. Because the SLT laser beam bypasses surrounding tissue leaving it undamaged by light, theoretically SLT can be repeated several times in eyes in which the IOP has risen to pretreatment levels or has not met the target IOP goal. Riansuwan *et al* [70] reported 24 eyes that had undergone multiple SLT procedures. Each treatment was performed on 270° of the TM. The mean IOP decrease observed after 1st SLT, 2nd SLT, 3rd SLT, and 4th SLT were 5.9±2.8 (25%), 3.5±3.0(17%), 4.2±3.7(21%) and 3.3±1.4mmHg(15%), respectively. This concluded that multiple repeat SLT treatments were effective in lowering the IOP in patients with glaucoma. The amount of IOP reduction was inversely correlated with number of repeat SLT procedures. Hong *et al* [71] also documented that repeat 360° SLT may be safe and effective after an initially successful 360° SLT failed.

SUMMARY

SLT is easy to perform and well tolerated by patients and offers the advantages of ALT while using much less energy with less apparent collateral damage to the TM. It seems to

have equivalent efficacy to topical latanoprost and to be an effective and safe glaucoma treatment without compliance risks or systemic side effects. But its IOP-lowering effect weakens gradually, its long-term efficacy is unproven and there are certainly risks to the procedure. We need evidence-based data to focus on not only IOP lowering effect but also visual function preservation after SLT.

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